ISSN 1346-7565 Acta Phytotax. Geobot. 61 (3): 145–150 (2011)

Carex noguchii (sect. *Rarae*, Cyperaceae), a New Species from Japan

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Carex noguchii J. Oda & Nagam. is described as new to science. It is similar to *C. biwensis* Franch. in having irregularly trigonous to pentagonous culms, many-flowered (ca. 30) spikes, and short (1.8–2.0 mm long) perigynia. *Carex noguchii* is distinguished from the latter, however, by the dark brown basal leaf sheaths, wider and longer leaves, orbicular-ovoid perigynia, and achenes loosely enclosed by the perigynia, and micromorphologically by the absence of satellite bodies.

Keywords: achene micromorphology, *Carex biwensis*, *Carex noguchii*, Cyperaceae, new species

Section *Rarae* C. B. Clarke is one of the unispicate groups of *Carex* with a single terminal androgynous spike (Clarke 1894). Section *Rarae* is highly diversified in eastern Asia and nine species and two varieties have been recognized in Japan (Ohwi 1936, Shimizu 2005, Oda & Nagamasu 2008, Katsuyama & Oda 2009).

Mr. Tatsunari Noguchi, the vice chairman of the Japanese Society of Cyperology, found an unusual sedge at Onuma, Nasushiobara-shi, Tochigi Pref., Honshu. The plant was similar to *Carex biwensis* Franch. in having smooth, irregularly trigonous to pentagonous culms, spikes with many flowers (ca. 30), and distinctly nerved perigynia 1.8–2 mm long. It was distinct from *C. biwensis*, however, in having dark brown basal sheaths, remarkably wide (to 4 mm) and long (to 60 cm) leaves, and orbicular-ovoid perigynia loosely enclosing the upper half of the achene. We propose these plants as a new species, *Carex noguchii* J. Oda & Nagam.

Materials and Methods

Herbarium specimens of *Carex* sect. *Rarae* in the herbaria KYO, OSA, TI, and TUS were examined. A field survey was carried out at Onuma, Nasushiobara-shi, in June 2010. The leaves of each herbarium sheet were measured at the widest part after boiling a portion of the leaf for 1 h. Cross sections ca. 0.1 mm thick of the culm and leaf were made by hand with a razor blade and stained with 1% crystal violet aqueous solution for 10 s, then observed and illustrated. The perigynia and enclosed achene were cleared with 5% NaOH aqueous solution for 10 min at 70°C and rinsed with water, then dehydrated through an ethanol series and observed in xylene by light microscopy. For achene micromorphology, the achenes were removed from the dissected perigynia and soaked for 6–10 h in an acetolyzing solution (concentrated sulfuric acid : acetic anhydride 1 : 9 v/v), then rinsed in acetic acid for 10 min, and placed in a bath type ultrasonic cleaner for 30 min with 70% ethanol to remove the cuticle and outer periclinal walls of the epidermis. After air drying, the achenes were sputter-coated with platinum using a JEOL JFC-1600 Auto Fine Coater, and examined using a JEOL JSM-6060 scanning electron microscope.

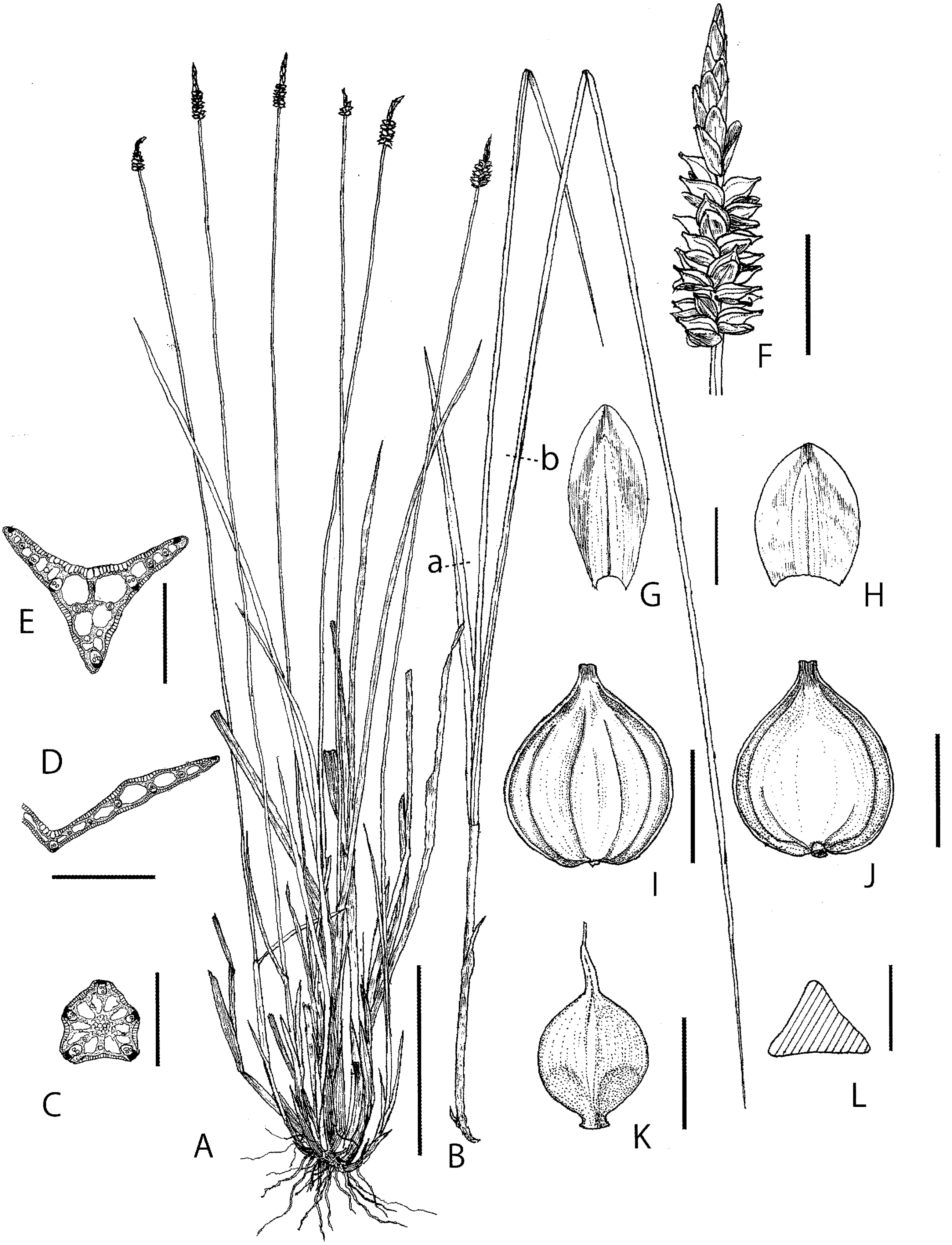

FIG. 1. *Carex noguchii* J. Oda & Nagam. A: habit at maturity in June. B: vegetative shoot in August. C: culm (cross section). D: outer leaf blade (cross section at dotted line a in Fig. 1B). E: inner leaf blade (cross section at dotted line b in Fig. 1B). F: spike. G; staminate scale. H: pistillate scale. I: perigynium (adaxial view). J: perigynium (abaxial view). K: achene. L: achene (cross section). Scale bar = 5 cm for A & B, 5 mm for F, 1 mm for C–E, & G–L.

TABLE 1. Morphological comparison between *Carex noguchii* and *C. biwensis*. All specimens represent the maturity period of each species.

Taxon	Locality	Altitude*	Voucher	Culm length (cm)	Leaf width (mm)		Perigynia			Satellite bodies
					Current year	Previous year	length (mm)	width (mm)	glandular dots	
Carex noguchii	Tochigi Pref.	960 m	*T. Noguchi s.n.*	37	2.0	3.2	2.0	1.3	absent	absent
	Tochigi Pref.	960 m	*J. Oda & T. Noguchi 4181-a*	45	2.5	4.0	2.0	1.3	absent	absent
	Tochigi Pref.	960 m	*J. Oda & T. Noguchi 4181-b*	33	–**	4.0	2.0	1.4	absent	absent
	Tochigi Pref.	960 m	*J. Oda & T. Noguchi 4181-c*	32	1.5	3.5	2.0	1.3	absent	absent
	Tochigi Pref.	960 m	*J. Oda & T. Noguchi 4181-d*	35	2.5	3.3	2.0	1.3	absent	absent
			mean ± SD	36.4 ± 5.2	2.13 ± 0.48	3.6 ± 0.38	2.0 ± 0.00	1.32 ± 0.04		
Carex biwensis	KOREA: Keinan	–	*T. Isomine s.n.*	24	1	1.3	1.9	1.1	present	present
	KOREA: Keinan	–	*J. Ohwi 7219*	39	1.2	1.5	2.3	1.0	present	present
	Miyagi Pref.	–	*G. Toba 346*	22	1.2	1.2	1.7	0.9	present	present
	Tochigi.Pref.	100 m	*T. Noguchi s.n.*	35	1.5	2.0	2.1	1.3	present	present
	Gifu Pref.	50 m	*H. Takahashi 22305*	55	1.5	1.8	1.9	1.2	absent	present
	Osaka Pref.	70 m	*K. Hirano s.n.*	35	1.1	1.3	1.8	1.0	present	present
	Hyogo Pref.	70 m	*J. Oda 1550*	45	1.2	1.3	1.8	1.1	present	present
	Kagawa Pref.	250 m	*J. Oda & S. Miytani 780*	41	1.7	2.0	2.0	1.2	absent	present
	Fukuoka Pref.	140 m	*Y. Koga 15052*	31	1.6	2.0	2.0	1.1	absent	present
	Oita Pref.	–	*Tak. Shimizu 86216*	43	0.8	1.6	1.7	1.1	present	present
			mean ± SD	36.8 ± 9.9	1.4 ± 0.29	2.0 ± 0.33	1.9 ± 0.19	1.10 ± 0.12		

Voucher specimens are all deposited in KYO. *Bars indicate the specimens without records. **No current year's vegetative shoots grown up yet.

Results and Discussion

Carex noguchii J. Oda & Nagam. **sp. nov.**—Figs. 1, 2A, 3A, & 4

Species nova affinis *Carici biwensi*, sed vaginis basilaribus atro-brunneis, foliis latioribus longioribusque, utriculis orbicularibus ovoideis, acheniis corporibus siliceis sine satellitibus differt.

Typus. *J. Oda & T. Noguchi 4181* (holo- KYO; iso- KPM, KYO, OSA, TI, TUS)

Herbs, perennial. *Rhizomes* abbreviated. *Culms* central, filiform, irregularly trigonous to pentagonous, smooth, 25–40 cm long, 0.8–1 mm in diam. *Leaves* on reproductive shoot to 5 cm long, ca. 1 mm wide, withered before flowering stem. Leaves on vegetative shoot growing after anthesis, to 60 cm long, to 4 mm wide; outer leaves V-shaped in cross section; inner leaves triquetrous; basal sheaths dark brown. *Spike* solitary, terminal, androgynous, narrowly ovoid, 10–16 mm long, staminate portion 8–15-flowered, pistillate portion 15–23-flowered. *Staminate scales* elliptic, apex obtuse, rusty brown, caducous, 2.1–2.5 mm long. *Stamens* 3. *Pistillate scales* ovate, apex obtuse, rusty brown, caducous, 1.5–2 mm long. *Perigynia* orbicular-ovoid, 1.8–2.0 mm long, 1.3–1.5 mm wide, nearly truncate, abruptly tapering to very short beak; nerves distinct on adaxial surface, indistinct on abaxial surface; glandular dots absent. *Stigmas* 3. *Achenes* ovoid, trigonous, upper half loosely enclosed by perigynium, light brown, dark brown at maturity, 1.3–1.5 mm long; apex of silica bodies of epidermis truncate, satellite bodies absent, anticlinal walls slightly undulate.

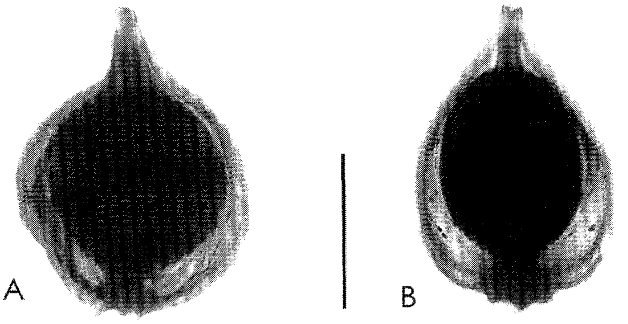

FIG. 2. Perigynium and enclosed achene of *Carex noguchii* and *C. biwensis*. A: Orbicular-ovoid perigynium of *C. noguchii* loosely enclosing achene, even in upper half (*J. Oda & T. Noguchi 4181*, KYO). B: Ovoid perigynium of *C. biwensis* tightly enclosing achene in upper half (Kobe-shi, Hyogo Pref., *J. Oda 1550*, KYO). Bar = 1 mm.

Japanese name. shimotsuke-harisuge (nov.)

Distribution. Japan, endemic: Honshu (Tochigi Pref.) (Fig.4)

Habitat. *Carex noguchii* is known only from a single moor at Onuma, Nasushiobara-shi, Tochigi Pref. The moor is located at ca. 1000 m alt. on the northern slope of the Takahara-yama volcanic group and is surrounded by temperate deciduous forests. Associates of *C. noguchii* are *Carex parciflora* Boott, *Quercus crispula* Blume and *Viburnum opulus* L. var. *calvescens* (Rehder) H. Hara.

Notes. The Japanese species of *Carex* sect. *Rarae* are generally deciduous. The reproductive shoots grow rapidly in early April to early May, followed by the vegetative shoots, which grow gradually after anthesis (usually from late April to early May) and elongate to become as tall as the fruiting stems at maturity (usually from late May to late June, see illustrations of *C. semihyalofructa* T. Shimizu [Shimizu 2005] and *C. koyaensis* J. Oda & Nagam. [Oda & Nagamasu 2008]). In *Carex noguchii*, however, the vegetative shoots grow after maturity of the fruiting stems. As shown at maturity of the fruiting culm in Fig. 1A, the current year's vegetative shoots are still few and small, with the withered leaves from the previous year's vegetative shoots conspicuous. At this stage, the leaves of current year's vegetative shoots are, if present, much narrower than those of the previous year's vegetative shoots (Table 1). After dispersal of the perigynia and the collapse of the reproductive stems, the vegetative shoots of *C. noguchii* grow rapidly. The leaves of the vegetative shoots grow to 60 cm long and 4 mm wide (Fig. 1B). The late growth of the vegetative shoots and the very large leaves, and the dark brown basal leaf sheaths are characteristic of *C. noguchii* in the Japanese species of sect. *Rarae*.

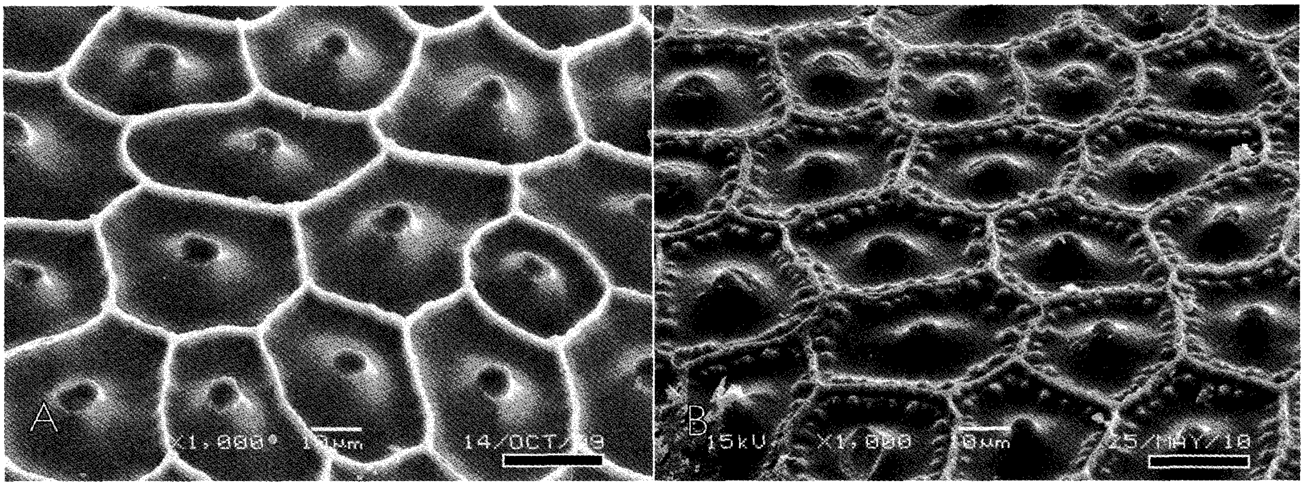

FIG. 3. Silica bodies on inner periclinal wall of epidermis of achene. A: *Carex noguchii.* central body abruptly truncate and lacking satellite bodies (*J. Oda & T. Noguchi 4181*, KYO). B: *Carex biwensis*, apex of central body rounded or truncate, with many satellite bodies regularly and serially arranged along anticlinal wall (Motegi-machi, Tochigi Pref., *T. Noguchi s.n.*, KYO). Bar = 20 μm

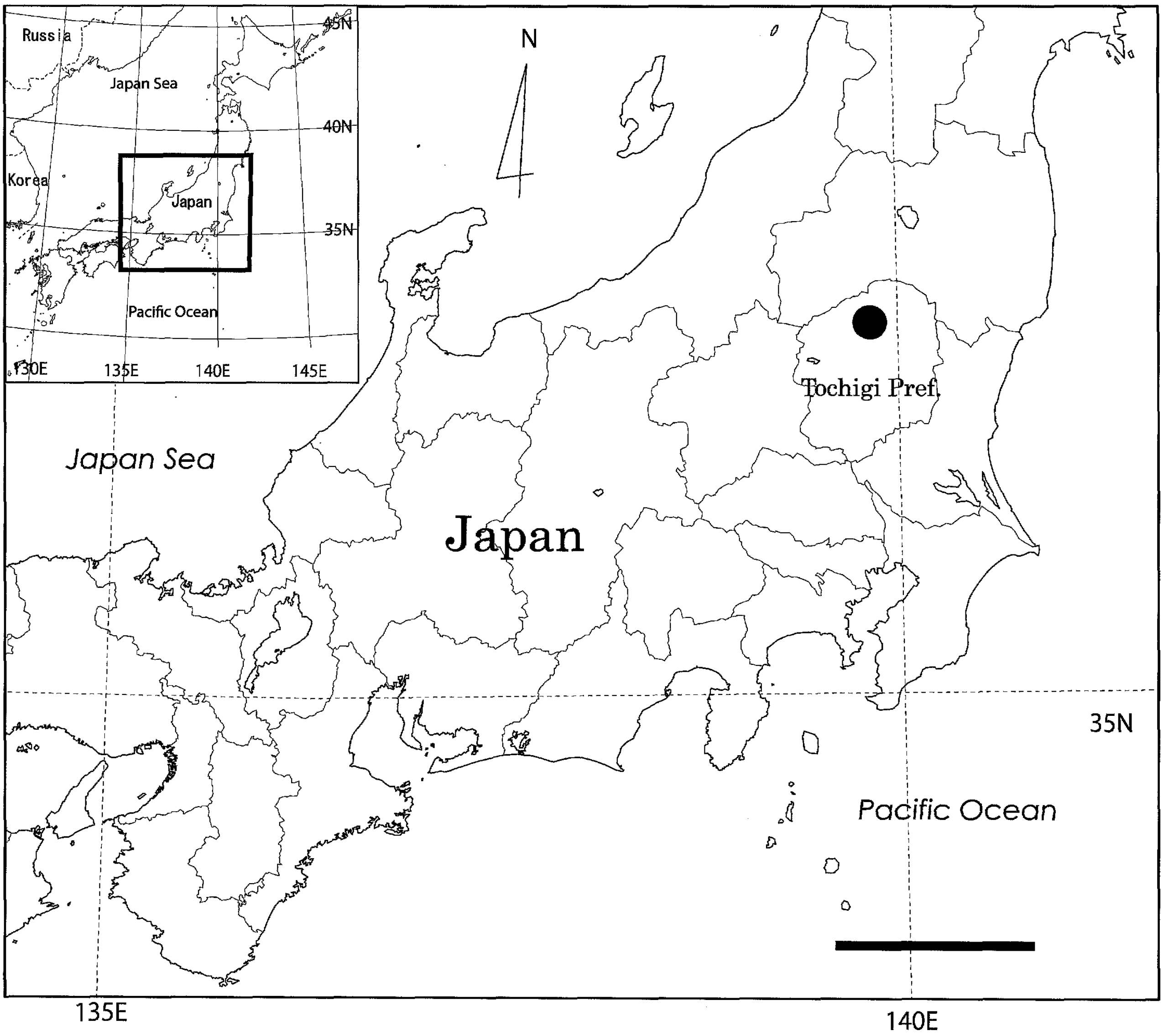

FIG. 4. Distribution map of *Carex noguchii.* Bar = 100 km.

Carex noguchii and *C. biwensis* are similar in the shape of the spike and in bearing many staminate and pistillate flowers. The two species have the shortest perigynia (1.7–2.1 mm long) in sect. *Rarae*. The shape of the perigynia, however, differs between *C. noguchii* and *C. biwensis*. *Carex noguchii* has orbicular-ovoid perigynia; *C. biwensis* has ovoid and narrower perigynia (Figs. 1I, H & 2 and Table 1; $P < 0.05$). As shown in Fig. 2, the achenes are loosely enclosed even in the upper half of the perigynium in *C. noguchii*, but are tightly enclosed in the upper half of the perigynium in *C. biwensis*.

The achene micromorphology clearly differs between *Carex noguchii* and *C. biwensis*. The silica bodies on inner periclinal walls of the epidermal cells lack the satellite bodies in *C. noguchii* (Fig. 3A), while ca. 20–25 satellite bodies are regularly arranged in a series along the anticlinal walls in *C. biwensis* (Fig. 3B).

Other taxa mentioned by some authors as being close to or synonymous with *Carex biwensis*, *C. rara* Boott (Kükenthal 1909, Liang *et al.* 2000), *C. pseudobiwensis* Kitag. (Liang *et al.* 2000) and *C. jankowskii* Gorodk. (Egorova 1999), are also distinct from *C. noguchii* in morphology.

We are grateful to Mr. Tatsunari Noguchi, Tochigi Pref., for providing excellent information and kind assistance in our field survey.

References

Clarke, C. B. 1894. Cyperaceae. *In*: Hooker, J. D. (ed.), Fl. Brit. India 6: 587–748.

Egorova, T. V. 1999. The Sedges (*Carex* L.) of Russia and Adjacent States (Within the Limits of the Former USSR). Missouri Botanical Garden Press, St. Louis.

Katsuyama, T. & J. Oda. 2009. *Carex koyaensis* var. *yakushimensis* (Cyperaceae), a new variety from Yakushima Island, Japan. J. Jap. Bot. 84(3): 191–193.

Kükenthal, G. 1909. Cyperaceae Caricoideae. *In*: Engler, H. G. A. (ed.), Pflanzenr. IV., 20 (Heft 38): 1–824.

Liang, S., L. Dai, Y. Tang & P. Li. 2000. Flora Reipublicae Popularis Sinicae 12. Cyperaceae (2). (in Chinese)

Oda, J. & H. Nagamasu. 2008. Two new species of *Carex* sect. *Capitellatae* (Cyperaceae) from Japan. Acta Phytotax. Geobot. 59(1): 55–66.

Ohwi, J. 1936. Cyperaceae Japonicae I. Mem. Coll. Sci. Kyoto. Imper. Univ. Ser. B, 11: 229–530.

Shimizu, T. 2005. *Carex semihyalofructa*, a new species of *Carex* sect. *Rarae* (*Capitellatae*) from Japan. Acta Phytotax. Geobot. 56(1): 33–39.

Received October 25, 2010; accepted December 3, 2010